EVALUATION OF SOME ESSENTIAL OILS AGAINST *SESAMIA CRETICA* LED. UNDER FIELD CONDTIONS

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Abstract: Efficacy of some volatile plant oils against the corn borer, *S. cretica* Led. was investigated under field conditions throughout 2010 early summer corn season . Oils of four plants, namely; Cinnamon, Clove, Marjoram and Ginger Essential oils were used at concentrations 2.5 and 5%. Also, Eugenol (aromatic fragment) which was found in all the essential oils was used in 4 concentrations. The recommended pesticide Diazinox ® was used in addition to the control treatment. It was found that Cinnamon at 5% achieved the highest percentage reduction in egg masses, larvae and dead heart being 95.2, 85.5 and 92.1, respectively. The heaviest yield of maize ears was obtained as a result of treating plants with cinnamon 5% and eugenol 0.4% being 89.9 and 86.2% increase than control, respectively.

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1. Introduction:

Maize (*Zea mays* L.) is one of the most economic cereal crops in Egypt. Flour is an essential food for the majority of farmers, while green maize plants are used as fodder for livestock animals and rabbits. Also, grain flour is added as main component of maize food industries. It is, also, used for human food after being mixed with wheat flour for bread production. In addition, it plays an important role in several industries important to Egypt's economy such as corn oil, fructose and starch production.

Maize plants are attacked by many insect species of which *Sesamia cretica* Led., which considered one of the most important, as larvae bore in the stems of seedlings causing deterioration of plants in the seedling stage, (Awadallah, 1974).

Many workers reported that many plants are considered to contain materials efficient for pests control. Such agents may be used as toxicants, repellents, synergists, growth regulators or antifeedants for many insect pests (Kubo and Clocke, 1982).

Essential oils may have attractive or repellent effects and in some cases they showed insecticidal action against certain insect pests. Oils isolated from plants which consist of cyclic and monocyclic mono-terpens proved effective repellents against insects (Rodriguez and Levin, 1975). It was found that these bioactive compounds are potentially toxic to insects and mites but relatively safe to human and wildlife. Recently, there is a great need to find alternative pesticides instead the traditional chemical insecticides which proved to have toxic effect on human, animal and on the whole environment. Some essential oils are extracted from natural sources, such as eugenol which is extracted from clove fruits (Farag *et al*., 1991). There was no significant difference between the retention of clove oil and Eugenol solutions, indicating that differences in their phytotoxicity to broccoli leaves was not due to differential foliar retention (Luke *et al*., 2006).

This study aimed to evaluate the efficacy among different plant extracts; Cinnamon, Cloves, Marjoram and Ginger, also Eugenol as (essential oils) against S. *cretica* infesting maize seedling in the field.

2. Material and Methods:

1-Experimental design:

This study was carried out throughout 2010 early summer corn season at the Experimental Farm of the Faculty of Agriculture at Moshtohor, Kalubiya Governorate. An area of about quarter feddan was chosen to be sown with maize seeds of the common commercial variety Giza 2. The area was divided to 48 plots of 3.5x3 meters each. Each plot contained five rows at a distance of 70 cm. sowing was done at rate of 3-4 grains/ hill, leaving a distance of 30 cm. between hills. Sowing took place on April, 17th as it was recorded to be the date of the highest natural infestation with *Sesamia cretica* Led, to maize plants (Awadallah, 1974 and Shalaby, 1996).

2-Materials used

Essential oils of each of the following materials were applied on four replicates/ treatment.

English name	Scientific name	Family	concentration
Clove buds	*Eugenia aromaticum*	Myrataceae	2.5 and 5%.
Cinnamon	*Cinramomum zeylanicum*	Lauraceae	2.5 and 5%.
Marjoram	*Majorana nortensis*	Labiolae	2.5 and 5%.
Ginger	*Zingiber officinale*	Zingiberaceae	2.5 and 5%.

Essential oils of the mentioned plant species were purchased from the local market.

Eugenol, 2-methoxy-4-(2-proporyl) phenol isolated from clove buds *Eugenia aromaticum* was purchased from (Shanghai Medical Instruments Co., ltd.). It was applied at 4 concentrations (0.1, 0.2, 0.3, and 0.4%) in the field.

The recommended pesticide (Diazinox) ®, (Organophosphorus- Diazinon) was applied at 5% concentration; i.e., 6 Kg /feddan and control treatment. A complete randomized block design with four replications was used. The assayed materials were sprayed by using one liter hand sprayer in case for the liquid materials while, Diazinox® granules was applied in the whorl of plant. Spraying was applied two times, the first 16 days after sowing, while, the second spray took place 7 days later. Data concerning the infestation by *S. cretica* egg-masses (20 randomly picked plants/plot) was recorded after 24 hours of first spray. Larvae (20 randomly picked plants/plot) were recorded after 24 hours of second spray. The perforated leaves and dead hearts were estimated per 50 plants /plot, after 35 days from sowing. At harvest all maize ears of each plot were collected, weighed and adjusted to find out the ear yield per feddan expressed as (ardab/feddan).

3-Statisical analysis

Data were subjected to ANOVA (Costat Statistical softwere, 1990). Means were compared using L.S.D.

3. Results and Discussion:

1. Number of egg-masses:

Results in Table (1) clearly showed that, all treatments caused significant reductions in the number of *S. cretica* egg-masses. The untreated plants harboured the highest number being 21 egg-masses /20 plants. The highest efficacy was obtained from treatment with cinnamon 5% being only one 1 egg- mass/ 20 plants, showing 95.2% reduction than control, followed insignificantly by marjoram 5% and Eugenol 0.4% (1.3 egg-masses/20 plants) indicating 94.1% reduction than control and Ginger 5% which gave 91.7% reduction. Treatments including Cinnamon 2.5 %, Ginger 2.5% Eugenol (0.3&0.2%) and Euegnol 0.1% achieved intermediate efficacy in which the egg-masses were 2.3, 2.5, 2.5, 2.8 and 3.3 egg-masses /20 plants as 89.3, 88.1, 88.1, 86.9 and 84.5% reduction than control, respectively. On the contrary, treatments that showed low efficacy were the marjoram 2.5%, clove 5&2.5% and the recommended chemical pesticide (Diazinox) (75, 75, 69.1 and 42.9% reductions, respectively).

In agreement with the present results, Abdel Samea (1998) indicated that jojoba oil inhibited hatchability of *O. nubilalis* eggs. The same author indicated also that jojoba oil had a promising ovicidal activity against *S. cretica* and *O. nubilalis*.

2. Number of *S. cretica* larvae:

Number of *S. cretica* larvae was counted in 20 plants for each treatment and presented in (Table (1). Untreated maize plants (control) received the highest infestation rate with *S. cretica* (38 larvae/20 plants). All assayed materials caused different efficacies on the *S. cretica* larval counts in maize plants leading to reductions in larval counts than control. The high efficacy was obtained by Cinnamon 5% and Marjoram 5% treatments which caused 85.5 and 83.6% reductions than control, respectively. Remaining treatments may be arranged descending by as Marjoram 2.5% (9 larvae/ 20 plants) indicating 76.3% reduction than control. Ginger 5% and Eugenol 0.4% and 0.3% caused 76.3, 74.3 and 73.7% reduction with averages of 9, 9.8 and 10 larvae /20 plants, respectively. Treatments of intermediate effect were Diazinox, Cinnamon 2.5%, Eugenol 0.2%, Ginger 2.5% and Eugenol 0.1% (12.0, 12.5, 14, 14 and 17 larvae /20 plants). On the contrary, Clove 2.5 and 5% resulted in the least efficacy reduction in the number against larvae (15.8 and 2.6% reductions than control, respectively; Table, 1).

These results agreed with Abdel-Aziz *et al.* (1995) who found that hexane and chloroform extracts of *Dodonaea viscose* gave the highest larval mortality against *Spodoptera littoralis.* Also Isman *et al.* (1991) revealed that neem products used as insecticide against the pyralid *O. nubilalis* showed moulteing disturbance, antifeedant and insect growth regulatory activities.

3. Numbers of plants containing perforated leaves:

As shown in table (1), all treatments gave reductions in plants with perforated leaves than control. This received 20 plants containing perforated leaves/50plants. Reductions in plants with perforated leaves than control ranged between 62.5 (after application of marjoram 2.5%) to 92.5 (Eugenol 0.4% treatment). Treatments which caused high efficacies may be arranged in descending order as Eugenol 0.3% (1.8 plants with perforated leaves; 91.3% reduction than control) Cinnamon 2.5%; (2.5, 87.5%), Ginger 5%; (3.5, 82.5%), Cinnamon 5%; (3.8, 81.3) Clove 5%; (3.8, 81.3), Eugenol 0.2%; (3.8, 81.3) and Marjoram 5%; (4.0, 80.0), respectively.

4. Numbers of dead heart cases:

As for the main symptom for *S. cretica* infestation is the dead hearted plants, which was recorded after 37 days from sowing. The untreated plants contained 19 dead heart cases/50 plants. Cinnamon 5%, Marjoram 5% and Eugenol 0.4% caused high reduction percentages than control, being 92.1, 90.8 and 90.8%. Eugenol 0.3% and Cinnamon 2.5% came next (82.9 and 86.8% reductions than control, respectively). The remaining treatments may be arranged in ascending order as Eugenol 0.1%, Marjoram 2.5%, Cloves 2.5&5%, Ginger 5%, Eugenol 0.2% and Diazinox (50.0, 57.9, 64.5, 71.1, 72.4, 75.0 and 79.0% reductions, respectively.

These results may be considered in harmony with those of Yacoub *et al.* (2010) who stated that the treatments which caused the best results against *S. cretica* egg-masses, larvae, number of dead hearts were Nat-com 40 (jojoba oil) and Tresser, water dodonia extract and sour orange extracted in petroleum ether. Subsequently, gained the highest yield of 26.7 ardab/fedan. Also, El-Hosary *et al.* (2010) data demonstrated that treatment with Runner alone, mixture of water radish extract and Protecto achieved the highest percentage reduction in number of *S.cretica* egg-masses, number of larvae, and plants containing perforated leaves and dead hearts, and led to the highest yield.

5. Dry ears yield

All treatments led to increases in the weight of harvested ears. The highest ears yield resulted from Cinnamon 5% treatment (24.5 ardab/feddan, showing 89.9% increase than control), followed by treatments with Eugenol 0.4%, Cinnamon 2.5% and Eugenol 0.3 which achieved 24.0, 22.5 and 22.2 ardab/feddan, respectively opposed to 12.9 ardab/ feddan from the control treatment. The remaining treatments may be arranged descending by according to the obtained yields as: Marjoram 5%; (21.8 ardab), Cloves 5%; (19.4 ardab) , Marjoram 2.5%; (18.9 ardab), Diazinox; (17.0 ardab)**,** Eugenol 0.2%; (16.8 ardab), Cloves 2.5%; (13.5 ardab), Ginger 5%; (15.1 ardab), Ginger 2.5%; (14.2 ardab) and Eugenol 0.1%;(13.0 ardab) indicating 68.7, 50.5, 46.8, 31.8, 29.9, 4.5, 16.8, 9.8 and 0.4 %increase in yield of maize ears than control (Table,1).

In this respect, El-Hosary *et al.* (2010) and Yacoub *et al.* (2010) data showed that there were significant negative correlation between yield and each of *S. cretica* traits (egg-masses, number of larvae, plants containing perforated leaves and dead hearts).

Constituents of each of the assayed essential oils were determined according to studies by different authors found in the literature. Oils were fractionated and identified using the Gas Liquid Chromatography (GLC) technique. These components may be demonstrated as follows:

1- Cinnamon essential oil

The chemical components of Cinnamon essential oil could be classified into 9 chemical categories namely; monocyclic terpen, bicyclic terpenes, aromatic hydrocarbons, aromatic ehydes, alcohols, phenol & phenol ethers , terpene esters , aromatic alchols and aromatic esters. These identified compounds counted for 90.4% of the composition of cinnamon essential oil. The Cinnamon essential oil phenol and phenol ethers which contains one compound namely; eugenol. These findings comply with those obtained by Lawiess, Julia (1992) and Burdock (1995), who reported that phenol content (as eugenol) represents from 4% to 10% from cinnamon by essential oil.

2- Clove essential oil

The chemical constituents of clove essential oil could be classified into 4 chemical categories namely; monocyclic terpen, ketone, sesquilerpene and phenol & phenol ethers. These identified compounds accounted for 99.12% of the composition of clove essential oils. The fourth chemical group was phenol and phenol ethers which consisted of 2 compounds namely; eugenol and eugenol acetate. These compounds were reported previously as constituents of clove essential oil by Furia and Bellanca (1975), Masada (1980), who found that eugenol acetate percentages in clove essential oil ranged from 75% to 95%.

3- Marjoram

Among 45 compounds recorded by gas chromatography of the water-distilled essential oil of marjoram (*Origanum majorana* L.), GC–MS and GC–FTIR 43 components were identified. This essential oil was found to be rich in terpinen-4-ol, cis-sabinene hydrate, p-cymene and γ-terpinene Vera and Chane-Ming (1999).

4- Ginger essential oil

The chemical constituents of ginger essential oil could be classified into 9 chemical categories namely; α cyclic terpenes, cyclic terpenes, bicyclic terpenes, oxides, alcohols, aromatic esters, phenol &

phenol ethers, sesquterpenes and aromatic hydrocarbons. These identified compounds accounted for 86.62% of the composition of this oil. The ginger essential oil was phenol and phenol ethers which consisted 2 compounds namely; benzene,1-methoxy-4-(2-propenyl) and eugenol. These compounds were reported as constituents of ginger essential oil by Masada (1980).

Table 1. Effect of some essential oils on *S. cretica* infestation in corn plants

Treatments	No. of egg masses /20 plants		No. of larvae /20plants		No. of plants with perforated leaves /50 plants		No. of dead heart / 50 plants		Yield (ardab /Fedden)	
	Average	% reduction	Average	% reduction	Average	% reduction	Average	% reduction	Average	% increase
Cinnamon 2.5%	2.3	89.3	12.5	67.1	2.5	87.5	2.5	86.8	22.5	74.4
Cinnamon 5%	1.0	95.2	5.5	85.5	3.8	81.3	1.5	92.1	24.5	89.9
Cloves 2.5%	6.5	69.1	32.0	15.8	4.3	78.8	6.8	64.5	13.5	4.5
Cloves 5%	5.3	75.0	37.0	2.6	3.8	81.3	5.5	71.1	19.4	50.5
Marjoram 2.5%	5.3	75.0	9.0	76.3	7.5	62.5	8.0	57. 9	18.9	46.8
Marjoram 5%	1.3	94.1	6.3	83.6	4.0	80.0	1.8	90.8	21.8	68.7
Ginger 2.5%	2.5	88.1	14.0	63.2	6.3	68.8	8.0	57. 9	14.2	9.8
Ginger 5%	1.8	91.7	9.8	©74.3	3.5	82.5	5.3	72.4	15.1	16.8
Eugenol 0.1%	3.3	84.5	17.0	55.3	6.3	68.8	9.5	50.0	13.0	0.4
Eugenol 0.2%	2.8	86.9	14.0	63.2	3.8	81.3	4.8	75.0	16.8	29.9
Eugenol 0.3%	2.5	88.1	10.0	73.7	1.8	91.3	3.3	82. 9	22.2	72.0
Eugenol 0.4%	1.3	94.1	9.8	74.3	1.5	92.5	1.8	90.8	24.0	86.2
Diazinox	12.0	42.9	12.0	68.4	6.0	70.0	4.0	79.0	17.0	31.8
control	21.0		38.0		20.0		19.0		12.9	
F value	192.2		148.3		119.7		52.5		31.5	
L.S.D.	1.1		2.6		1.2		1.8		2.2	

The results obtained in this study may be in harmony with those obtained by Tiwari *et al.* (1998) who reported insect repellent activity of the Cinnamomum essential oil. These results may, also, agree with those previously reported by Chaieb *et al*. (2007). They tested the biological activity of *Eugenia caryophyllata* on several microorganisms and parasites, including pathogenic bacteria, Herpes simplex and hepatitis C viruses. In addition to its antimicrobial, antioxidant, antifungal and antiviral activity, the authors indicated also that clove essential oil possesses antiinflammatory, cytotoxic, insect repellent and anaesthetic properties.

Abd El-Aziz and El hawary (1997) mentioned that basil, *O. basilicum* showed an insecticidal action against *Spodoptera littorals* larvae (80% larval mortality) and that basil, *O. basilicum* gave 94.34%repellency to *S .littoralis* moths.

Isman (2000) reported that certain plant essential oils and/or their constituents have a broad spectrum of activity against insect and mite pests, plant pathogens and other fungi and nematodes. Accordingly, they have considerable potential as crop protectants and for pest management in other situations (e.g. urban pest control). Current information indicates that they are safe to the user and the environment, with few qualifications. As a cautionary note, the essential oils that are most efficacious against pests are often the most phytotoxic; this latter property requires serious attention when formulating products for agricultural and land-scape use. Also, selectivity among invertebrates is not well documented. Honey bees appear somewhat susceptible (Lindberg *et al,* 2000), and the susceptibility of various natural enemies has yet to be reported, although the lack of persistence of essential oils under field conditions, they could provide some measure of temporal selectivity favoring these non- target species.

Essential oils may have attractive or repellent effects and in some cases they showed an insecticidal action against insects. Essential oils isolated from plants and consisting of cyclic and monocyclic monoterpes are effective repellents against insects. Rodriguez and Levin (1975) reported that the ideal essential oil insecticide would consist of compounds that are active against pest arthropods, while being harmless to beneficial and safe for human and the environment.

(Cavalcanti *et al*. 2004) reported that the essential oils of *O. arnericanum* and *O. gratissimun* had larvicidal activity against *Aades aegyptii* Masquito and caused 100% mortality at a concentration of 100ppm. *O. americanum* showed toxicity to the hairy caterpillar, *Euproctis fraternal* (Mc Indoo, 1983).

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